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HYDRO GEO CHEM, INC.

Groundwater Consultants

Confidential Claim Retracted
Authorized by: [redacted]
Date: 6/25/13

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MEMO TO: Ron Solimon, Pueblo of Laguna
Pat Wise, Pueblo of Laguna
Frank Jones, Bureau of Indian Affairs
Marc Nelson, US Geological Survey

FROM: Hydro Geo Chem, Inc.

SUBJECT: Progress of Work on Pueblo of Laguna; February 1981.

Hydrogeology: Potentiometric surface maps were completed for formations in the Jurassic and lower Cretaceous systems. These include the Entrada, Bluff, Westwater Canyon, and Jackpile-Dakota. There is a general steepening of the hydraulic gradient as these waters flow into the Rio Puerco Fault Belt.

Areas of potential vertical ground-water flow were identified. Areas of potential upward flow are in the northwest parts of the San Juan Basin, and in the Bernabe Montano Grant-Rio Puerco Fault Belt area. This type of water movement is typical for discharge areas in sedimentary ground-water basins.

Areas of downward water movement, from the Cretaceous into the Jurassic, could only be identified in a few areas. The most important of these appears to be from the Mt. Taylor area. Recharge from faults west of the San Mateo mine may be as high as 1-2 CFS (Kunkler, 1979; SJBRUS working paper). The Dakota exhibits some mounding as a result of this recharge.

Geochemistry: Analysis of water samples in the southeastern part of the basin show a general mixing of waters from Permian through Cretaceous, with a slight dilution upward. This indicates upward movement of water through the fault system. From this and the hydrologic data above, the Rio Puerco Fault Belt can be catagorized as an area with reduced horizontal, and enhanced vertical permeability.

Under Mt. Taylor the Dakota Formation waters show a little freshening. This also suggests that there is recharge occurring in this aquifer. There are no chemical or hydraulic head data to suggest that recharge occurs to the Westwater Canyon.

Geology: The final versions of the geologic map, geologic sections, isopachous and structure-contour maps were prepared and drafted. Facies and lithologic variation maps were prepared for the layers to be used in the numerical model. The final version of the geologic report was completed.

Numerical modeling: A preliminary difference map was developed for the calibration and steady-state simulations. This grid covers, roughly, the southeastern one-third of the San Juan Basin. The boundaries of the steady-state grid and probable hydraulic boundary conditions are described below.

1) No flow along a streamline extending northeasterly from the Gallup Sag to the San Juan Mtns;
2) Prescribed head along the Naciemento Uplift;
3) Prescribed head in the Rio Puerco Fault Zone and outcrop area in the Pueblo;
4) Prescribed flow along the Rio San Jose;
5) No flow in the Acoma Sag and Mt. Taylor monocline;
6) Prescribed head in the outcrop area north of the Zuni Uplift;
7) No flow in the Gallup Sag.

The model will consist of four layers:

Layer 1: all units of the San Rafael Group;
Layer 2: Morrison Formation (Recapture, Westwater Canyon, Brushy Basin);
Layer 3: Jackpile sandstone and lower Dakota Sandstone;
Layer 4: upper Dakota units and lower Mancos Shale.

The effects of confining beds on flow between these layers will be simulated by adjusting values of vertical hydraulic conductivity and bed thickness.

Based on discussions with Pete Balleau, BIA, the withdrawal scenarios studied in transient simulations will include withdrawals from present and planned uranium mining and milling operations. To study the impact of future development whose locations and withdrawals cannot now be defined, drawdown in the Pueblo per unit withdrawal in various mining districts will be computed and presented graphically.